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What defines a geochemical map? Implications for environmental assessment.

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Abstract

The environmental quality of land is often assessed by the calculation of threshold values which aim to differentiate between concentrations of elements based on whether the soils are in residential or industrial sites. In Europe, for example, soil guideline values exist for agricultural and grazing land. A threshold is often set to differentiate between concentrations of the element that naturally occur in the soil and concentrations that result from diffuse anthropogenic sources. Regional geochemistry and, in particular, single component geochemical maps are increasingly being used to determine these baseline environmental assessments. The key question raised in this paper is whether the geochemical map can provide an accurate interpretation on its own. Implicit is the thought that single component geochemical maps represent absolute abundances. However, because of the compositional (closed) nature of the data univariate geochemical maps cannot be compared directly with one another. As a result, any interpretation based on them is vulnerable to spurious correlation problems. What does this mean for soil geochemistry mapping, baseline quality documentation, soil resource assessment or risk evaluation? Despite the limitation of relative abundances, individual raw geochemical maps are deemed fundamental to several applications of geochemical maps including environmental assessments. However, element toxicity is related to its bioavailable concentration, which is lowered if its source is mixed with another source. Elements interact, for example under reducing conditions with iron oxides, its solid state is lost and arsenic becomes soluble and mobile. Both of these matters may be more adequately dealt with if a single component map is not interpreted in isolation to determine baseline and threshold assessments. A range of alternative compositionally compliant representations based on log-ratio and log-contrast approaches are explored to supplement the classical single component maps for environmental assessment. Case study examples are shown based on the Tellus soil geochemical dataset, covering Northern Ireland and the results of *in vitro* oral bioaccessibility testing carried out on a sub-set of archived Tellus Survey shallow soils following the Unified BARGE (Bioaccessibility Research Group of Europe).